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INT CL[5] B65D 39/12 39/16 41/28 45/02

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(54) Closure devices with compressible core seal

(57) A closure device for a bottle or other container includes a compressible core seal 12 within or adjacent the cap 10 such that under axial pressure applied by the cap 10 through a central shaft 23, the core seal 12 expands radially to form a seal within the container neck or outlet. As shown, the seal 12 initially exerts axial pressure on the cap away from itself but when closed, passes a biassing position and then provides tension in the opposite direction to maintain the closure. Alternatively (see Figures 1, 15), the cap 10 may include means to engage the bottle and the core seal 12 is only able to exert pressure so as to push the cap away. The central shaft may be hollow to form a nozzle 73. In this case a valve plate 74 is provided with slots 75 radially outwards of the nozzle such that when in the closed position, the central shaft 23 engages the valve plate 74 to effect a seal.

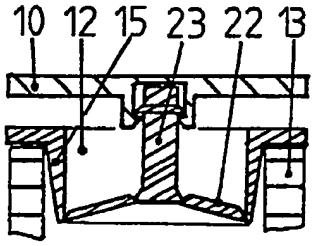

FIGURE 5

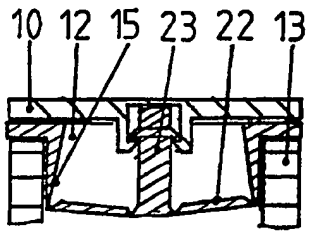

FIGURE 7

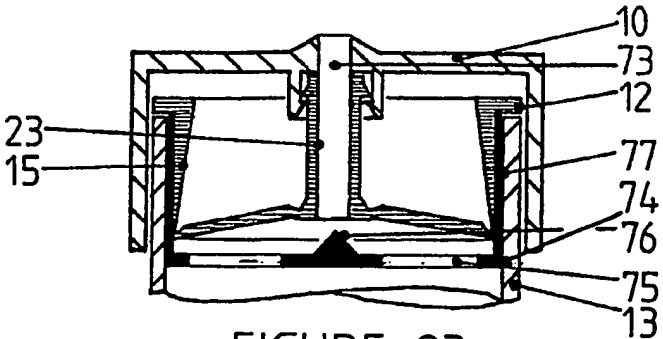

FIGURE 23

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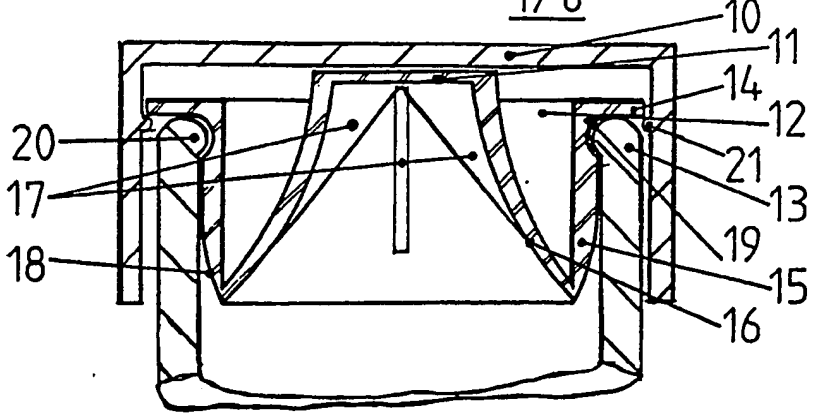


FIGURE 1

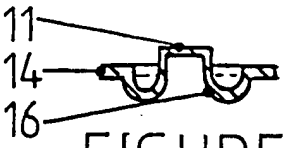
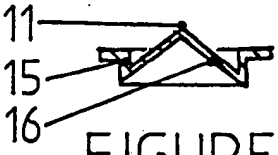


FIGURE 2



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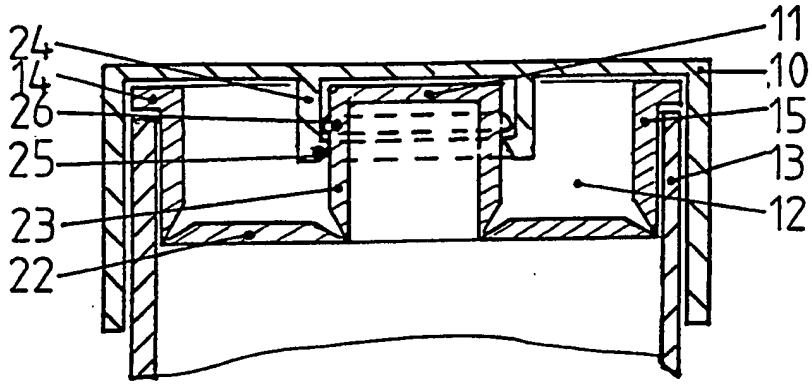


FIGURE 4

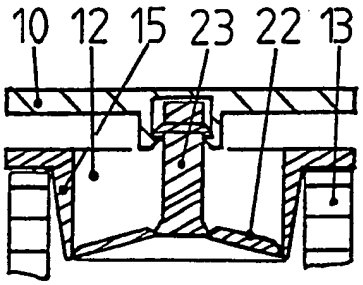


FIGURE 5

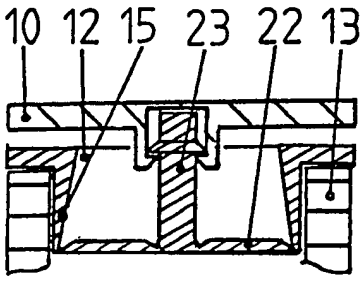


FIGURE 6

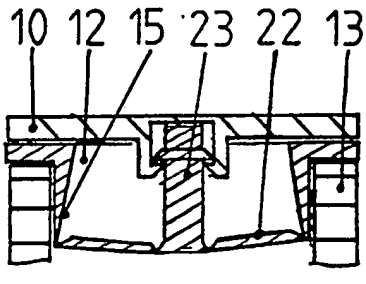
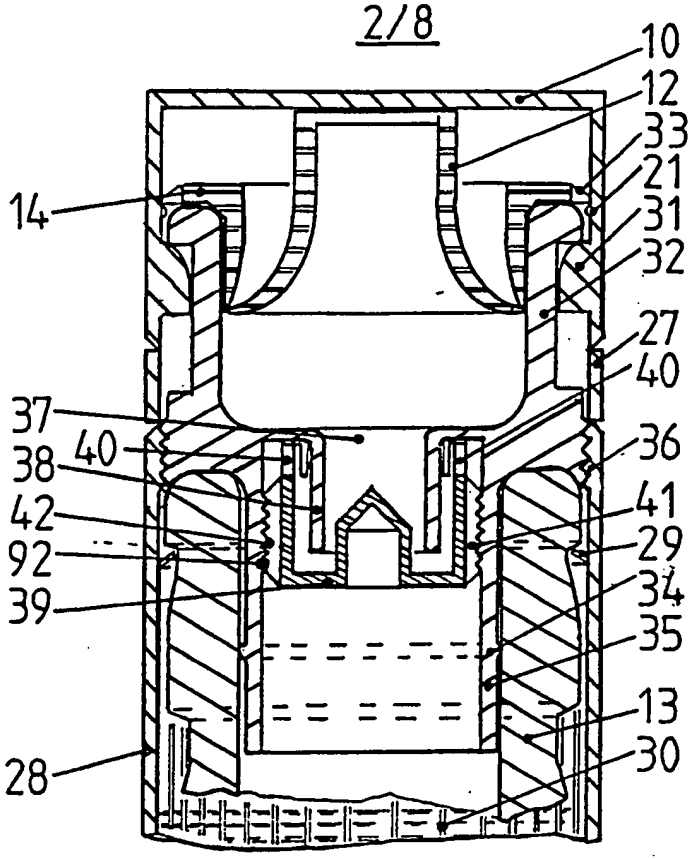


FIGURE 7



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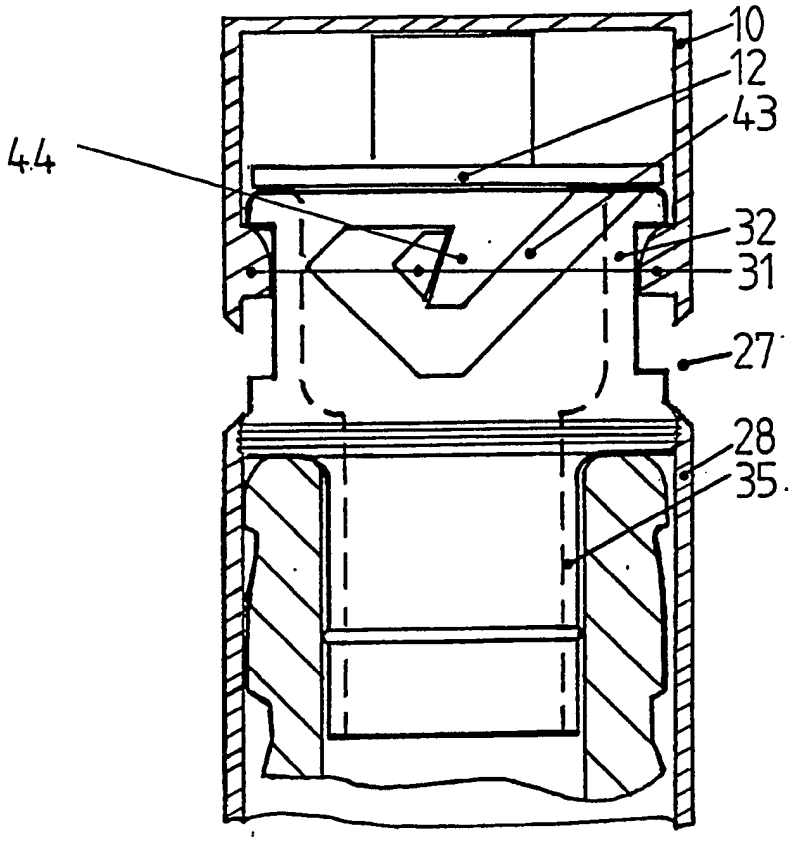

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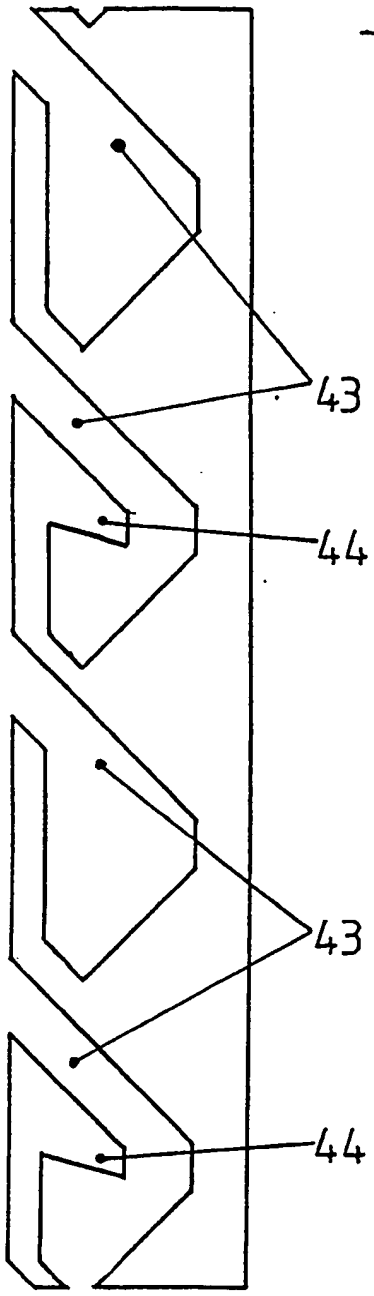

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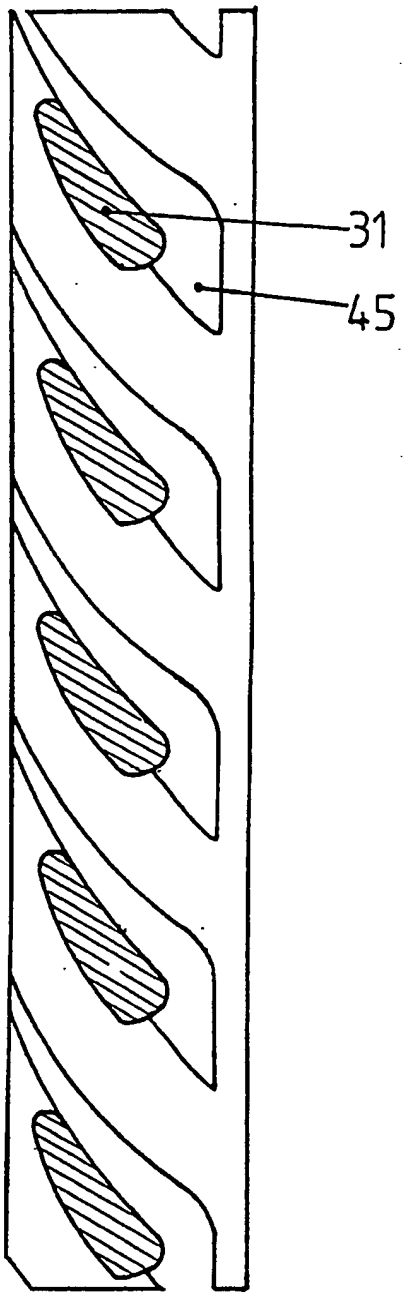

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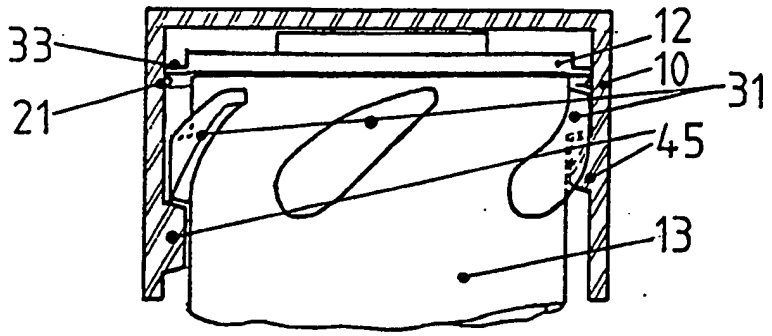


FIGURE 12

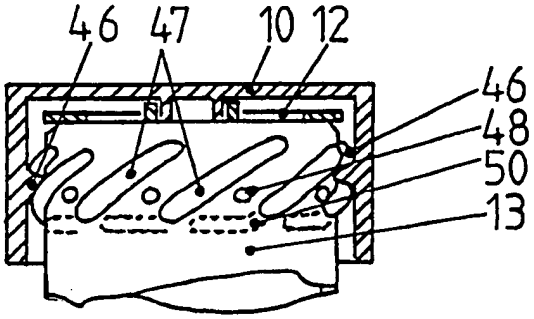


FIGURE 13

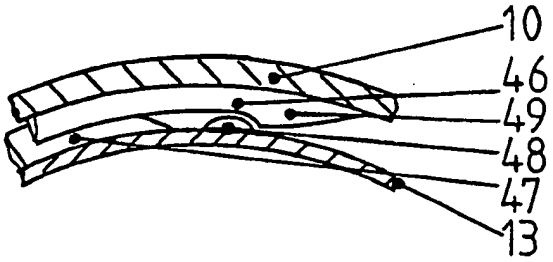


FIGURE.14

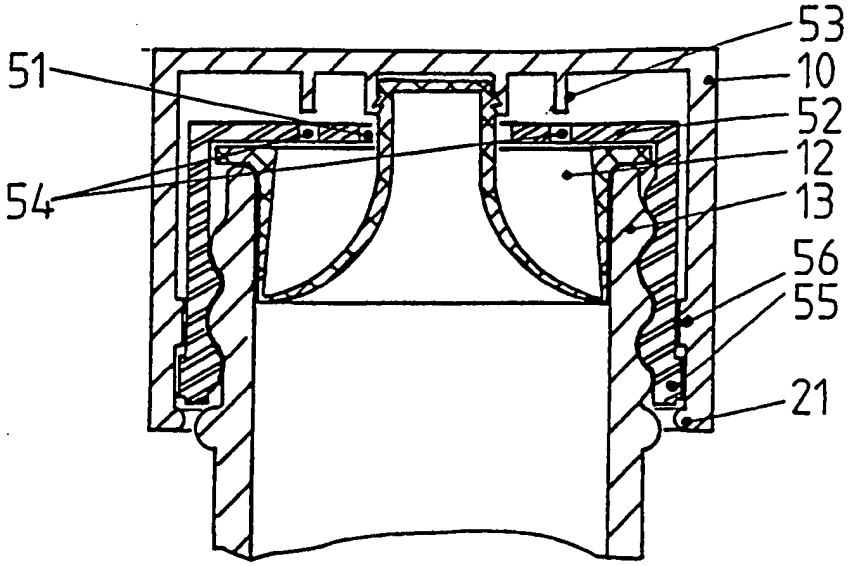


FIGURE 15

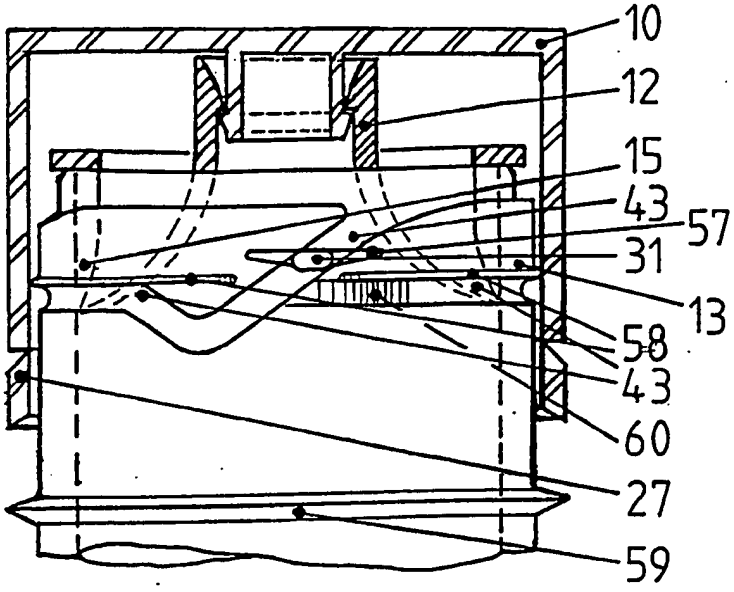


FIGURE 16

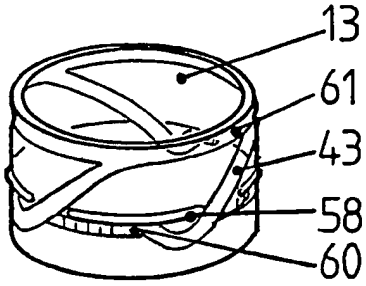
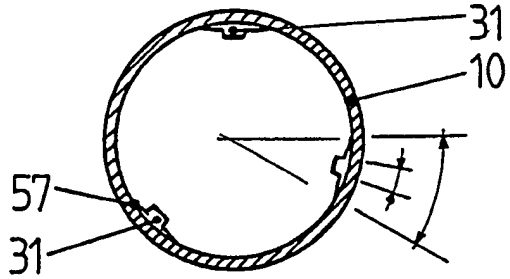


FIGURE 17



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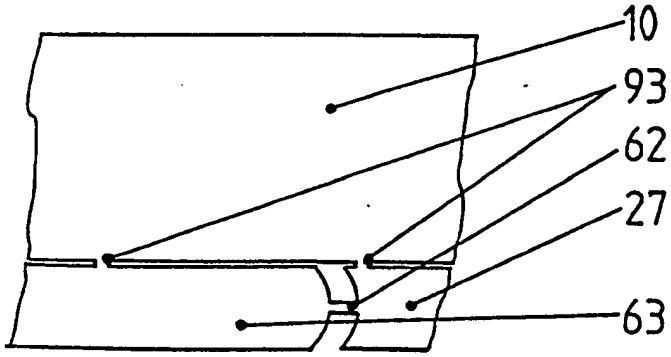

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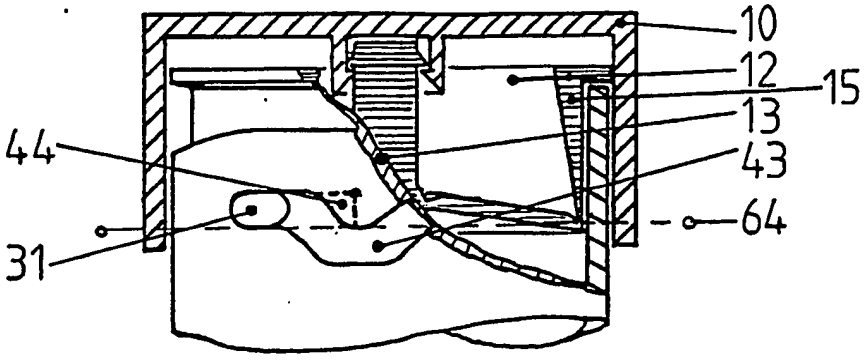

FIGURE 20

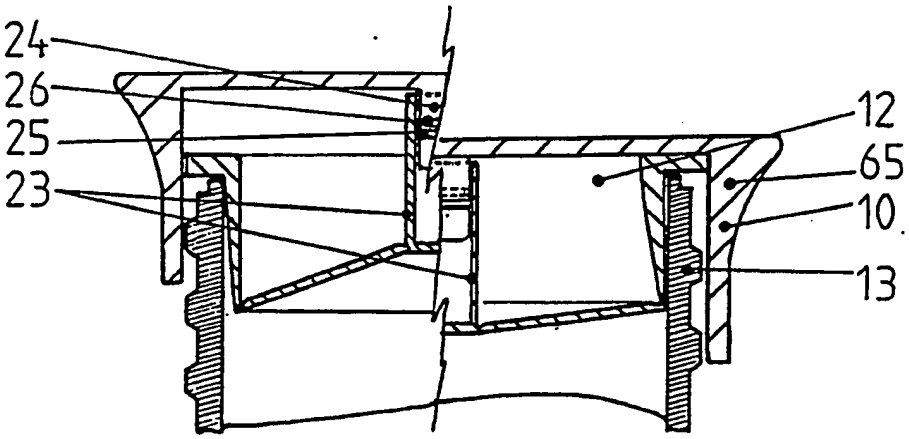

FIGURE 21

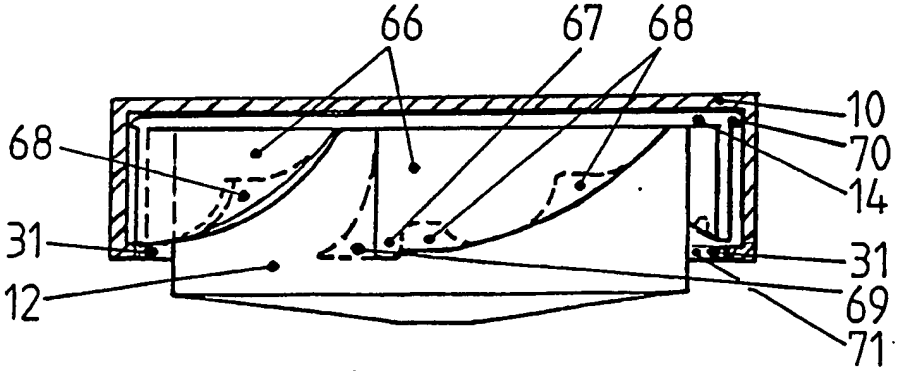

FIGURE 22

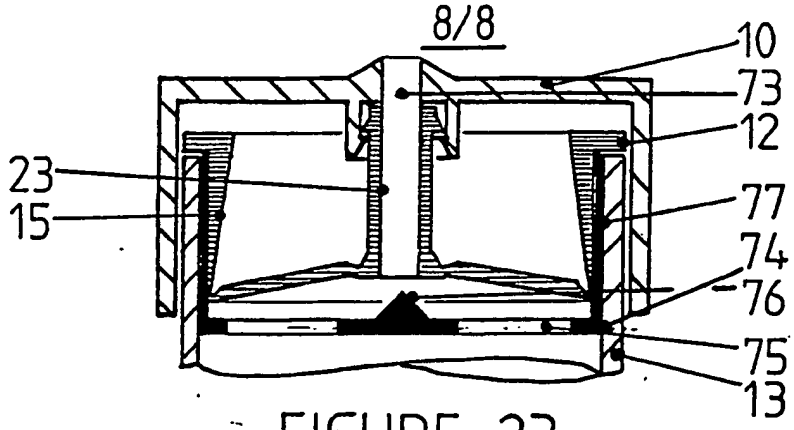

FIGURE 23

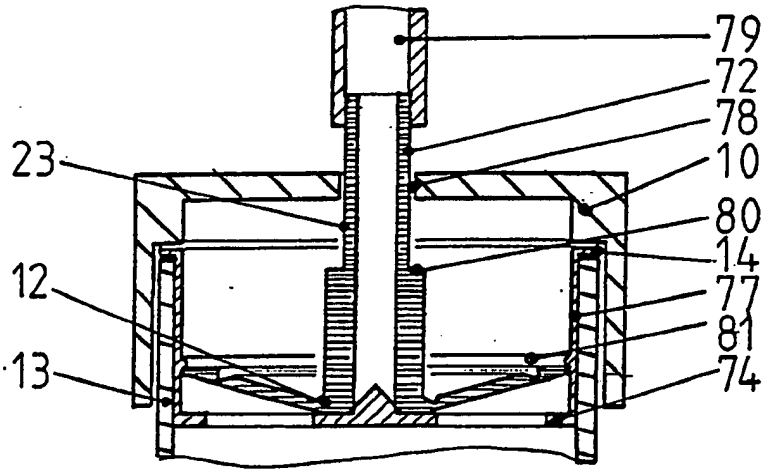

FIGURE 24

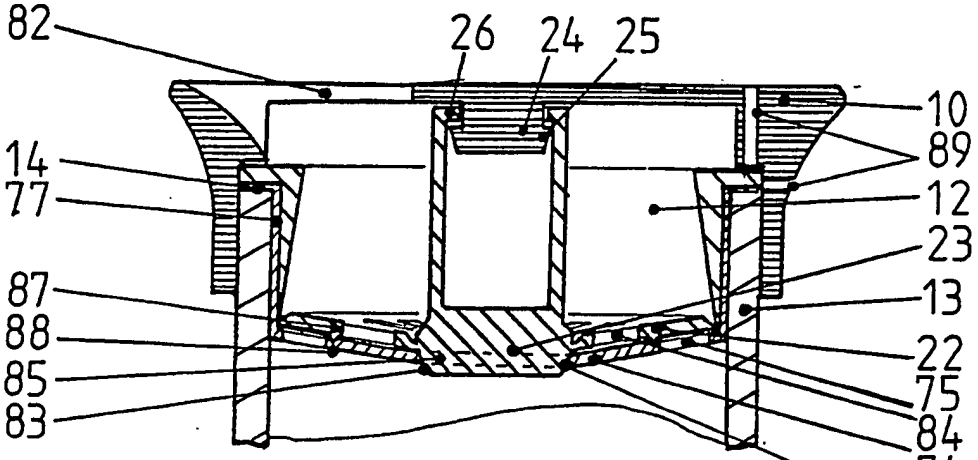

FIGURE 25

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CLOSURE DEVICES WITH COMPRESSIBLE CORE SEAL

This invention relates to closure devices featuring a compressible core seal suitable for container closures.

In Patent GB2155985 a design was proposed which would possess the advantages of long and short helical threads without their disadvantages; it would be quick to operate and would attach at a predetermined torque rather than against the friction experienced in conventional threaded connections. This design required "resilient means acting axially between the two members tending to urge them apart thus holding the lugs or spigots at the end of the path in the fastened position." This includes conventional means such as compressible wadding and expanded plastic foam as well as inherent resilience in the cap itself or a form of sprung insert within the cap. However, some forms of closure require considerable axial movement which conventional means do not provide.

The seal between a container and its closure has to be effective, and is conventionally achieved by means of a core (or bore) seal, a face seal, a skirt seal, or a combination of these. The core seal operates circumferentially within the neck of the container while the face seal operates on the surface of the ring formed by the container neck and the skirt seal operates circumferentially on the outside of the container neck where the skirt or bottom inner face of the cap may abut a shoulder formed there. Conventional core seals are limited by the practicable interference between the inner diameter of the container neck and the outer diameter of the core seal. Face seals are limited by the pressure applied, e.g. by rotation of the cap in the case of conventional threads, and can give security problems at the bottling stage if this pressure is insufficient. This problem is particularly evident if induction sealing is used to weld a tamper evident cover to a thermoplastic container neck, as is frequently the

case. This causes slight axial shrinkage and allows the closure to slacken off or undo itself. Skirt seals ar not practicable alone, as the contents would seep into the closure mechanism, e.g. the helical threads in a conventional closure.

According to the present invention there is provided a closure device with a compressible core seal attached within the lid, top or cap to be applied to a bottle, tube, tin, jar or other container such that once in place within the neck or outlet of the container the device will expand circumferentially outwards under downward axial pressure creating a tight seal within the core or bore of said neck or outlet. The compression of the core seal will also act axially between the other two members tending to urge them apart, or in an alternative form the core seal will react at a certain point and urge them together. This provides resilience in novel forms of closure and combined with an internal valve plate may be adapted to provide a sealable spout or nozzle upon the cap.

When viewed as if in place on an upright bottle or container, the compressible core seal will typically comprise a horizontal ring which provides a face seal to the container neck top, upon the inner diameter of which is formed a vertical skirt such that the outer diameter of such skirt is slightly less than the inner diameter of the container neck. From the bottom of such skirt will connect inwards and upwards towards the centre of the horizontal ring and to a high point or apex vertically above such central point an inner skirt which will deform elastically if force is applied axially downwards upon it. A proportion of this axial force will be applied by means of the inner skirt to the base of the outer skirt, which will in turn expand outwards thus gripping the container and forming a core seal in addition to the face seal provided by the horizontal ring. Such outer skirt and face sealing ring may be omitted if other means of vertical location and sealing, e.g. an annular shoulder or ring

is provided internally upon the neck upon which the inner skirt may rest. The geometry of the inner skirt may vary according to the required application and if formed with a relatively flat section forming a base or lower skirt between the outer skirt and the centre of the core seal from which rises a central pin, tube or shaft to the high point or apex before described then pressure downwards upon this central high point will cause the outer skirt to expand as before. However, once the flat base of the lower skirt passes the horizontal position the axial force which it has exerted upwards as a result of its confinement within the container neck will cease and become an axial force downwards and if its motion is then limited by the co-operation of cap and container top it will hold the two components together without mechanical assistance. Whatever geometry is selected, it may be necessary for the desired application to provide strengthening in the form of buttresses or thicker section to the skirts in order to control the deformation of the core seal under downward axial pressure. The height of the said central apex above the face sealing ring as formed will govern the extent of the axial travel permitted to the cap in the closed position.

The compressible core seal as described above will generally require to be secured within a lid, top or cap in such a way as to allow relative rotation of these two elements after the seal has tightened within the container neck. This may be achieved at the outer diameter of the horizontal face sealing ring by means of the ring or a projection or projections therefrom being detained above an annular ring or beads upon the inner surface of the cap skirt. Alternatively this can be achieved at the centre or apex of the inner skirt of said core seal by means of co-operating projections from the central portion of the cap and from said core seal. This would take the form of pin or cylinder interconnected with tube or shaft by means of annular chamfered shoulders, circumferential rings or projections thereon. If desired a circumferential recess in the outer

face of the outer skirt may be provided to co-operate with an inward circumferential projection from the inner face of the container neck as with conventional core seal devices.

Although invented in order to facilitate use of the Easily Operated Fastening Device of Patent GB2155985 the compressible core seal here described may also be used in conjunction with other existing means of closure or, in its embodiment featuring a lower skirt described above, independent of other means of attachment. In such a form it will require to be raised from the closed position past its point of maximum tension where the lower skirt is roughly horizontal by applying manual pressure upwards on the lid or cap thus raising the central connection between the cap and the inner skirt, after which it will spring free. In order to facilitate this operation without recourse to other mechanical means upon the container neck, ramps may be provided in the following manner to raise the lid or cap by means of rotation. The horizontal face sealing ring is extended so that its outer diameter is greater than the outer diameter of the container neck, and from its circumference several curved projections of angular profile are formed downwards creating tracks, guides or ramps for a number of co-operating lugs or spigots projecting inwards from the cap skirt, from which an additional annular ring or beads may be desired to limit the axial travel of the mechanism. The tracks, guides or ramps should be shaped in order to give the optimum mechanical advantage to operate the mechanism and optionally incorporate a detent slot or cutaway at its lower end to provide a secure closure and a greater downward projection at the lower end of the ramp to provide an end stop beyond which the lugs or spigots on the cap will not rotate. A further slot or cutaway should be provided at some point along the track, guide or ramp if it is required for use with a valve and spout arrangement. Alternatively, a complete concentric ring may be provided in place of the ramps or guides, upon the outer face of which are formed recessed or

projecting tracks which co-operate in similar fashion with lugs, spigots or scrolls formed upon the inner face of the skirt of lid or cap, although for manufacturing reasons this is likely to be less desirable.

Should a valve and spout arrangement be required, the lid or cap will be held securely on the container while allowing material to flow past a plate, forming a valve within the container neck and thence through a central shaft or cylinder and out through a central hole in the upper face of the lid or cap. It will also be necessary to provide a valve plate which would typically comprise a flat ring of outer diameter slightly less than that of the container neck with holes, slots, cut-outs or perforations between the central radial area and the outer radial area of such ring with an optional central projection in the form of a cone to provide tight sealing when pressing against the core seal in its lower position. This projection would fit within a hollow shaft formed in the central pin, tube or shaft of the core seal mechanism which would either be secured centrally within the cap or lid as before described and connecting with the central hole, spout or nozzle provided in the centre of the cap or lid or else extended through the cap or lid via a hole provided therein of larger inner diameter than the outer diameter of such central pin, tube or shaft. In this case operation of the mechanism would be by means of axial force applied to the pin, tube or shaft external to the cap or lid. A wider section would be required at the base of such pin, tube or shaft to limit its axial movement which could be provided either by means of an annular projection or ring on its outer circumference of larger diameter than the inner diameter of the central hole or by forming a larger outer diameter to the shaft or tube for a proportion of its length thus providing a ridge or shoulder at the point of maximum required upward travel. The plate would be secured in place by means of an upward skirt of cylindrical form with walls of thin section to allow it to flex in concert with the outer skirt of the core seal, and would form an interference fit with

the outer skirt if the whole assembly was required to be fitted in one piece, e.g. at the bottling stage of the manufacturing process. The whole skirt would require to be of sufficient depth to allow the core seal to flex downwards with adequate force to create an airtight seal against the centre of the valve plate or pin thereon if provided. If required a face sealing ring may also be provided at the upper edge of the valve plate skirt.

An alternative form of this co-operation between core seal and valve plate could be provided by having the central pin, tube or shaft as before described and attached to the lower skirt but without the vertical cylindrical skirt and face seal and ideally having a relatively thicker section forming a ring at its outer circumference. Such a ring would register with an annular ring or rings formed upon the inner face of the valve plate skirt creating an airtight seal between the central shaft and the valve plate with the core seal in its lower or closed position as tensioned against the valve plate, and hold said core seal open in its upper position while retained in tension by means of the annular projection, ridge or shoulder on the shaft abutting on the inner face of the lid, top or cap. The walls of the valve plate skirt may be formed of thicker section and a face sealing ring may be formed upon its upper edge if required. It may be desirable to provide mechanical means of connection between the lid, top or cap and the container neck by means of helical scrolls or annular rings in conventional manner. This would allow the assembly to be attached to an existing container by the conventional means provided thereon. Furthermore, in order to regulate the axial movement of the mechanism, a concentric ridge or shoulder may be provided within the cap at the upper edge of the inner face of its skirt forming a seal against the face seal of the mechanism. Due to the lack of provision for return air to the container, these forms are most suitable for use with flexible containers.

Should a greater flow than is permitted by the arrangement described above be required, or if an eccentric pouring hole, spout or lip be required, provision for return air will be necessary. This can be accommodated by forming such an aperture in the cap, ideally upon its upper face, with a connection from the said cap to the central pin, tube or shaft of the core seal mechanism and with novel or conventional means of attachment to the container neck all as before described. The lower skirt of the core seal which flexes to provide the axial force could be provided upon its lower face with a concentric projecting ring and holes, slots or cut-outs either within the radius of such ring or between such ring and the outer circumference of the said lower skirt. In this case the core seal would ideally be provided with an outer skirt and face sealing ring as before described. The valve plate would be arranged to press firmly against the whole face of the lower skirt of the core seal mechanism at its lower or closed position with a concentric groove to register with the concentric projecting ring to provide an airtight seal between the holes, slots or cut-outs formed in the lower skirt of the core seal as described above and holes, slots or cut-outs formed in the valve plate on the other side of such airtight sealing ring, i.e. of greater radius if the core seal is perforated at lesser radius and vice versa. The central pin, tube or shaft may also be shaped to penetrate a concentric hole formed in the centre of the valve plate creating a valve which when raised will allow fluid or granular material to pass through the holes, slots or cut-outs in the lower circular portion of the core seal and out through the spout formed in the cap. Optional air shafts may be provided in the cap either on its upper surface or on the circumference of its skirt on the side diametrically opposite the spout in such a way that in the lower position they would be closed by the face sealing ring and in the upper position they would be open to the internal cavity formed by the cap and core seal. In practice a combination of these features will be found practicable for most uses for which a spout would be desired.

The compressible core seal may be utilised in an assembly which is attached to a standard glass container such as is used by distillers to prevent adulteration of their products. The cap bearing the core seal will in this case have a frangible connection to a tamper-evident strip which is in turn frangibly connected to a lower skirt thus forming an integral tamper-evident outer case which is attached to an inner assembly or pouring neck. Said pouring neck is formed with recessed tracks on its outer circumference which engage with lugs or spigots formed on the inside of the cap skirt, optionally featuring detent sections to provide a child resistant closure as described above. It is attached to the container neck by means of a cylindrical projection forming a conventional core seal and attached to the outer skirt by means of horizontal annular rings, and features a further downward cylindrical projection within said projection to co-operate with an insert to form a non-return valve in the form of an airlock. Such airlock insert will take the form of a cylinder of greater height than the aforesaid inner cylindrical projection, having a flat base and central raised projection (which should be conical in form to withstand pressure through the pouring neck in case of abuse) and holes, slots or cutaways in its upper annular surface. Vertical ribs bearing horizontal teeth or ribs are formed on its outer circumference to locate it within the pouring neck in co-operation with horizontal annular rings or ribs on the inner circumference of the outer cylindrical projection from the pouring neck which attaches within the container neck.

When the container is initially opened, the downward pressure applied by the tracks upon the lugs will break the connection between the cap and the tamper-evident strip and allow removal of the cap. The contents may then be poured through the airlock, which allows fluid to flow outward through the holes, slots or cutaways past the inner cylindrical projection and through the neck while air is allowed to enter the container by way of the holes, slots or cutaways on

the side which is relatively higher when the container is tilted. Foreign material is however prevented from entering the container by the pressure within said container as said material fills the airlock. Removal of glass from within the assembly is prevented by extending the lower skirt of the outer case and the cylindrical core seal within the container neck to as great a height as is practicable for the given container neck.

The core seal may also be used in conjunction with novel means of attachment as now described where it is detained within a cap bearing multi-start helical scrolls and fits within the container neck which is provided with matching scrolls and projections in some form, e.g. beads, outward within the recess between said scrolls. Matching projections from the inner diameter of the scrolls upon the cap at their lower end or leading edge will co-operate with the projections formed on the container neck to secure the cap in place at a predetermined torque. An optional detent in the form of a bar or bars or shoulder upon the neck at the lower edge of said scrolls may be used to limit the movement of the scrolls formed upon the cap and the said projections may equally be formed at a different level within the closure.

In the case of a closure utilising inner and outer caps to provide child resistance, the core seal will require to be connected centrally to the cap by way of an aperture or hole provided in the inner cap so that engagement of means to drive the inner cap is by downward pressure against the resilience of the core seal. Novel means of engagement are herein provided by way of an internal projection or projections from the inner surface of the outer cap registering in holes, slots or cut-outs in the upper surface of the inner cap, by means of annular rings of vertical ribs or teeth arranged at different heights upon the outer circumference of the inner cap and the inner circumference of the outer cap, or by means of forming the central hole in the

upper surface of the inner cap in a shape other than circular and providing a corresponding shape around the central connection between the cap and the core seal. In each case operation will be by downward pressure and rotation as before described and such means may be used in combination, particularly if the said projection or projections are in the form of ramps and the said vertical ribs or teeth are arranged in the form of a ratchet so that one element will drive the inner cap clockwise while the other element will drive the inner cap anticlockwise.

Should a particular application require engagement in one orientation only, this can be achieved by spacing the lugs or spigots and their related tracks irregularly around the circumference of the cap and the container neck provided that a form of closure provided by Patent GB2155985 is used. A suggested angular value for such lugs and spigots as measured clockwise being zero degrees, 115 degrees and 225 degrees approximately. It may also be desirable to provide a tamper-evident strip upon the cap which will deform outwards when the closure is initially operated. The said strip is conventionally attached to the cap by means of frangible connections and is detained upon the neck by means of interconnecting projections forming a ratchet between the container neck and the inner surface of said strip above a chamfered shoulder or ring formed upon the neck. The downward axial force consequent upon such initial operation will force the strip outward over the chamfered shoulder or ring causing a frangible connection provided laterally in the strip to break thus allowing it to be removed by its loose end.

In the following drawings it is not intended to exclude features from another Figure from each specific embodiment but rather to provide a basis for their combination in specific applications.

Specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings which are generally in vertical section owing to the conventional circular form of container necks and in which:

Figure 1 shows the essential features of the invention.

Figure 2 shows an alternative form of the invention.

Figure 3 shows another alternative form of the invention.

Figure 4 shows an alternative form of the invention having different mechanical characteristics.

Figures 5, 6 and 7 show the stages of the action of the invention as embodied in Figure 4.

Figure 8 illustrates the use of the invention within a tamper-resistant assembly suitable for a standard glass neck as used in the wine and spirits trade.

Figure 9 shows a section on the cap revealing a suitable operating mechanism for the assembly shown in Figure 8 as provided by Patent No. GB2155985.

Figure 10 shows the projection in strip form of the circumferential tracks shown in Figure 9.

Figure 11 shows the projection of the circumferential tracks of another closure form provided by Patent No. GB2155985.

Figure 12 shows a section on the cap revealing the invention in conjunction with the form shown in Figure 11.

Figure 13 shows an alternative novel form of closure.

Figure 14 shows a sectional detail from Figure 13 viewed from above.

Figure 15 shows the invention as utilised in a pharmaceutical type of closure.

Figure 16 shows a section on the cap and the compressible core seal revealing a container neck featuring a novel child resistant closure.

Figure 17 illustrates the container neck form of such a closure.

Figure 18 illustrates a suggested angular configuration to provide child resistance in such a closure.

Figure 19 shows a configuration for an optional tamper-evident strip suitable for closures shown herein where desired.

Figure 20 shows a section on the cap with partial section on the container neck revealing the use of the invention as embodied in Figure 4.

Figure 21 illustrates the action of the invention as embodied in Figure 4 independent of other means of attachment.

Figure 22 shows a section on the cap revealing the invention as embodied in Figure 4 with integral mechanical means of attachment.

Figure 23 shows the invention as embodied in Figure 4 in conjunction with an insert to form a valve.

Figure 24 shows an alternative arrangement to Figure 23 incorporating a spout.

Figure 25 shows an alternative arrangement to Figure 23 and Figure 24 to provide greater flow by allowing for return air and to provide an eccentric spout.

Referring to the drawings, Figure 1 shows the lid, cap or top (hereinafter called the cap) 10 at rest on the central section 11 of the compressible core seal (hereinafter called the core seal) 12 placed within the container neck 13 prior to closure, the face sealing ring (hereinafter called the face ring) 14 supporting said cap 10 by means of a vertical outer skirt 15 inner skirt 16 and said central section 11. Strengthening by means of optional buttresses 17 is also shown. Downward axial pressure on the central section 11 consequent upon closure is transferred by way of the inner skirt 16 to the vertical outer skirt 15 resulting in a pressure tight seal between the outer face of the vertical outer skirt and the inner face of the container neck 13 while the cap 10 is held in place thereon by mechanical means not shown here. The height of said central section 11 above the face ring 14 as formed governs the axial

travel permitted to the cap 10 in the closed position. The vertical outer skirt 15 is shown with optional features namely an inward curving outer face 18 and an annular groove 19 which registers with a conventional annular core seal ring as featured on the container neck 13. Said vertical skirt 15 and face ring 14 may be omitted if other means of vertical location as before described are provided. The core seal 12 is retained within the cap 10 in this case by an annular ring 21 or segments thereof formed upon the inner face of the skirt of the cap 10.

In Figure 2 and Figure 3 the core seal 12 is shown in alternative forms each having face ring 14 and inner skirt 16 but in Figure 2 there is no defined outer skirt 15 and in Figure 3 there is no defined central section 11 notwithstanding which these forms will function as in Figure 1.

Figure 4 shows a different configuration of the core seal 12 comprising cap 10 central section 11 face ring 14 and outer vertical skirt 15 secured to container neck 13 but featuring a flat annular section (hereinafter called the lower skirt) 22 connecting said outer skirt 15 to a central pin, tube or shaft 23 (hereinafter called the central shaft) formed vertically downwards from the central section 11. Such core seal 12 is secured to the cap 10 by means of a projection 24 in the form of pin or cylinder as required which is formed downwards from the inner face of the cap 10 and provided with an internal or external annular chamfered shoulder or ring 25 or segments thereof which registers with an external or internal annular chamfered shoulder or ring 26 or segments thereof formed upon the outer face of the central shaft 23. This configuration has a different characteristic to the forms of core seal 12 before described when axial force is applied to the central section 11 relative to the face ring 14 as in closure of the cap 10 onto the container neck 13. This is

illustrated with reference to Figures 5 to 7 which show the closure principle in its most basic diagrammatic form.

In Figure 5 the lid 10 rests in the elevated or open position supported by the central shaft 23 of the core seal 12 within the container neck 13.

Figure 6 shows the effect of axial force downwards upon the cap 10 in displacing the outer skirt 15 radially outwards against the inner face of the container neck 13. However, beyond the point of axial movement shown, i.e. the 'over-centre position', the lower skirt 22 itself exerts a downward axial force upon the central shaft 23 thus holding the core seal 12 and the cap 10 firmly together.

Figure 7 shows the core seal 12 in such closed position and exerting downward axial force to hold the cap 10 closed against the container neck 13.

Figure 8 demonstrates the embodiment shown in Figure 1 as applied to a tamper resistant assembly such as is used in the wine and spirits trade in conjunction with a closure mechanism which is illustrated in Figure 9. The cap 10 is here provided with an integral tamper-evident strip 27 and extended skirt 28 which is attached to the container neck 13 by means of an annular flap 29 and prevented from rotation by means of vertical projecting ribs 30 on its inner face which engage with lugs provided on the container neck 13 as a standard feature. The cap 10 is shown in its locked or closed position detained by a plurality of lugs or spigots 31 formed on its inner surface in co-operation with recesses formed upon the pouring neck 32 under upward axial force exerted by the core seal 12 which is shown detained within the cap 10 by means of several horizontal projections 33 from the face ring 14 registering with an annular ring 21 formed upon the inner face of the skirt of the cap 10 although

alternative means as before described may be used. The pouring neck 32 is secured in place by means of a conventional core seal 34 upon an extended cylindrical section 35 within the container neck 13 and an arrangement of interconnecting annular rings 36 formed upon its outer circumference and the inner face of the extended skirt 28 of the cap 10 and has a concentric aperture 37 extended downwards within said cylindrical section 35 in the form of a cylinder 38 in order to provide a 'one way valve' or airlock in co-operation with an insert as now described.

The airlock insert 39 is cylindrical in form having an indented or raised core (which should ideally be conical in its upper portion to resist pressure through the pouring neck 32) attached to its outer cylinder by means of a flat circular section joining the two at their bases, having cutaways or slots 40 fashioned in the said outer cylinder from its upper annular face and having vertical ribs 41 formed outwards upon its outer circumference which engage with the inner surface of the cylindrical section 35 of the pouring neck 32 within the container neck 13, being detained in place by means of annular rings 92 formed upon the said inner surface which engage with horizontal ribs or teeth 42 (i.e. such portions of a set of annular rings as are capable of being formed upon such set of circumferential ribs 41) upon said ribs 41, the whole said airlock insert 39 being made of a tough material so that it will resist attempts to remove or otherwise tamper with it and prevent ingress of foreign material while allowing the contained material to flow outward when the container as a whole is tilted for pouring. Said extended skirt 28 should be formed to the greatest height practicable for the given standard neck in conjunction with similar extension of the said cylindrical section 35 in order to prevent removal of the glass neck finish therefrom in case of abuse.

Figure 9 shows the assembly in Figure 8 as sectioned through the cap 10 to disclose a preferred form of closure mechanism, after the removal of the tamper-evident strip 27 which frees the upper portion of the cap 10 from its extended skirt 28 and permits some degree of rotation and vertical or axial motion of the cap 10 while in its locked or closed position as defined by the recessed tracks 43 formed upon the outer face of the pouring neck 32 in their action upon the co-operating lugs or spigots 31 formed upon the cap 10 thus providing a child resistant characteristic to the closure. A plurality of detent sections 44 are provided to this end and in order to remove the cap 10 from the pouring neck 32 it will be necessary to depress and rotate the cap 10 and its associated lugs or spigots 31 within said recessed tracks 43 against the axial pressure of the core seal 12 until such rotation causes the lugs or spigots 31 to reach the upper end of said recessed tracks 43 thus separating the cap 10 from the pouring neck 32, while reattachment will merely require contrary rotation. The child resistant feature is optional to the user inasmuch as the closure need not be fully rotated. The cap 10 may be detained by other means herein provided and the core seal 12 may be in an alternative form herein provided. This figure varies from Figure 8 in that the airlock feature is omitted and the core seal 12 is illustrated as being connected to the cap 10 by means of a central connection as provided in Figure 4.

Figure 10 shows the recessed tracks 43 from Figure 9 as projected in strip form at the same scale and shows the detent sections 44 in two diametrically opposing positions such as may be the most practical for thermoplastic or thermoset manufacture. Sharp corners will be radiused as necessary to facilitate operation.

Similarly in Figure 11 an alternative form of the mechanism provided in Patent No. GB2155985 is shown projected in strip form at the same scale, which is a

closure form particularly suitable for thermoplastic manufacture. The lugs or spigots 31 are shown shaded in the engaged or closed position relative to the scroll forms 45. The lugs or spigots 31 would be formed upon the outer face of the pouring neck 32 if used in an assembly such as that shown in Figures 8 and 9 or upon the outer face of the container neck 13 in a simple application as shown in Figure 12 while the scrolls 45 would be formed upon the inner face of the cap 10 in either case, although by inverting the form shown here these relative positions may be reversed. As can be seen, anti-clockwise rotation in the conventional sense of the cap 10 bearing the scrolls 45 will disengage said lugs 31 and scrolls 45 at their lower connective faces allowing the right hand face of said scrolls 45 to bear upon the left hand face of said lugs 31 forming a guide for their relative disconnection while reconnection will be achieved by clockwise rotation of the cap 10 relative to said pouring neck 32 or container neck 13. Resilient means such as the core seal 12 will be required to tension such action.

Figure 12 shows the embodiment of Figure 11 as described, in a simple container closure where the core seal 12 is detained by means of a circumferential projection 33 and annular ring 21 as before described although alternative means as before described may be utilised. Due to the small axial movement involved to lock the mechanism in its engaged position the use of the core seal 12 may not be necessary but may be replaced by means as before described. The cap 10 is shown held in place upon the container neck 13 by the co-operation of the 'tick' shaped scrolls 45 formed upon its inner surface with lugs or spigots 31 formed upon the container neck all as before described. This embodiment is of particular use where induction sealing as used in the bottling process to attach a metallic membrane across the annular face of the container neck 13 since the vertical shrinkage of said container neck 13 under these conditions

can allow a conventional helical scroll connection to become loose and possibly detach at a later time.

Figure 13 shows the cap 10 and core seal 12 in the closed position attached by means of multi-start helical scrolls 46 to the container neck 13 which is provided with similar scrolls 47 upon its outer surface and some form of raised projections 48 upon its outer face between the lower portions of said scrolls 47. These will engage with raised projections 49 as shown in Figure 14 upon the inner diameter of the said scrolls 46 upon the cap 10 at their lower section or leading edge as shown in Figure 14 when the cap 10 is applied to the container neck 13 to detain the cap 10 at a predetermined torque. Such co-operating raised projections 48 and 49 may equally be formed elsewhere upon the said scrolls 46 and container neck 13 and it may be desirable to provide a bar or detent 50 either as a horizontal extension of a number of scrolls 47 or in some other form upon the lower portion of the outer face of the container neck 13 in order to provide an end stop to the movement of the scrolls 46 upon the cap 10.

Figure 14 shows the typical operation of the projections described in Figure 13 as seen from above. The cap 10 with its associated scroll 46 and projection 49 from its inner diameter has been rotated clockwise to reach its engaged position where said projection 49 has passed over the outward projection 48 on the outer circumference of the container neck 13 between the scroll 47 and its identical neighbouring scroll which is omitted from the view for clarity.

Figure 15 shows the core seal 12 utilised in a form of closure used in the pharmaceutical industry for child resistance where the outer cap 10 rotates freely on the inner cap 52 thus preventing opening of the closure unless certain actions are performed to engage the outer cap 10 and inner cap 52 so that said inner cap 52 can be disengaged from the container 13. Here the core

seal 12 is attached as before described to the cap 10 through a central hole 51 provided in the upper surface of the inner cap 52 which is secured to a standard helical threaded or scrolled container neck 13 and detained inside the outer cap 10 by means of an annular ring 21 or portions thereof formed upon the lower portion of the inner face of the skirt of the outer cap 10. The opening operation may be by a variety of known means upon anticlockwise rotation with downwards axial pressure against the tension exerted by the core seal 12. Alternatively this may be effected as shown here by means of a projection or projections 53 formed downwards upon the inner face of the cap 10 in co-operation with suitably formed holes, slots or cut-outs 54 provided in the upper surface of the inner cap 52 or by means of a set of vertical circumferential ribs or teeth 55 provided upon the outer face of the inner cap 52 in co-operation with a similar set of circumferential ribs or teeth 56 provided upon the inner face of the outer cap 10 formed at different heights within the closure so that in either case operation will be by depression and rotation as before described. Alternatively engagement may be effected by shaping the central hole 51 in the inner cap 52 in a form other than circular and providing a corresponding form circumferentially around the central connection between the core seal 12 and the cap 10 in such a way that the cap 10 when depressed and rotated will rotate the inner cap 52. Connection and disconnection can equally be made by a combination of such novel means especially if the circumferential teeth 55 and 56 are provided in the form of a ratchet or if the downward projection or projections 53 are provided in the form of ramps so that one of the elements described above will drive the inner cap 52 clockwise while another element will drive said inner cap 52 anticlockwise.

Figure 16 shows the cap 10 attached to the core seal 12 as embodied in Figure 1 in its rest position as supported by said core seal 12 and connected to the

container neck 13 by means of a plurality of lugs or spigots 31 (of which one is shown for clarity) having in this case horizontal extensions 57 in the form of portions of an annular ring of greater internal diameter than the inner surface of the lugs 31, all of which are formed upon the inner circumference of the cap 10 and registering with recessed tracks 43 impressed upon the outer face of the container neck 13 having a form from Patent No. GB2155985. When rotated clockwise to close or lock the cap 10 in place, the lugs or spigots 31 and associated extensions 57 will pass through gaps in a segmented annular ring 58 which is formed on the outer circumference of the container neck 13 at its juncture with the upper face of the horizontal portion of the recessed tracks 43 in order to secure said lugs or spigots 31 and cap 10 more firmly in their closed or locked position. Further clockwise rotation will cause the lugs or spigots 31 upon the cap 10 to pass the lowest portion of the tracks 43 before rising into their closed or locked position as detained by the horizontal portion of the recessed tracks 43 and segmented annular ring 58. As before described, opening is achieved by reversing these actions. An optional tamper-evident strip 27 is shown attached to the lower face of the skirt of the cap 10. The said strip 27 will deform outwards when the closure is first operated as it is forced downwards against a chamfered shoulder or ring 59 by the action of the closure mechanism, such deformation causing the said strip 27 to fracture as shown in Figure 19.

If the recessed tracks 43 and their associated lugs or spigots 31 are spaced irregularly around the circumference of the closure this will form an effective child resistant closure, particularly if a detent 44 as shown in Figure 9 is utilised within the recessed tracks 43. Such a cap 10 could only be opened in one angular orientation marked for example by means of aligning an arrow visible on the container neck 13 with another arrow formed on the cap 10. A diminution of the depth of the recessed tracks 43 at their leftward extremity

is shown as a transition 60 which will permit complete rotation as required in this case while the cap 10 is detained on the container neck 13. Alternatively the recessed tracks 43 may be terminated prior to their 1 ftward extremity and the annular ring segment 58 extended vertically downward to form an end stop at their termination point; additionally a detent section 44 may be added to any aforesaid track 43. Equally, the form of core seal 12 embodied in Figure 4 may be utilised.

Figure 17 illustrates the container neck 13 as shown in Figure 16 formed in a clear material showing the general arrangement of unevenly or irregularly spaced recessed tracks 43 segmented annular ring 58 and transition sections 60 all as described in Figure 16. An optional annular recess 61 forms an extension to the recessed tracks 43 so that the cap 10 may be detained on the container neck 13 e.g. if it is required that an outlet in the form of a slot on the circumference of the skirt of the cap 10 or a spout be provided in the cap 10.

Figure 18 shows three lugs or spigots 31 with horizontal extensions or beads 57 as before described in Figures 16 and 17 arranged upon the inner face of the skirt of the cap 10 in an unevenly or irregularly spaced pattern in such a way that alignment of the closure members for removal or attachment is only achieved in one orientation, the suggested angular values for the centrelines of the lugs or spigots 31 as measured clockwise from zero at the top being approximately 115 degrees and 225 degrees and the suggested angular values for the circumferential extent of the lugs or spigots 31 and their associated beads 57 being approximately 10 degrees and 30 degrees respectively.

Figure 19 shows a length of the tamper-evident strip 27 shown in Figure 16 of conventional form except that a frangible connection 62 is formed laterally within the circumference of such strip 27 in addition to the conventional

frangible connections 93 formed upon the lower annular surface face of the cap 10. As the mechanism as described in Figure 16 exerts a downward axial force the lateral frangible connection 62 will break showing evidence that tampering has taken place and allowing manual removal of the strip 27 at its loose end 63.

Figure 20 shows the cap 10 attached to the container neck 13 (shown in part section) by means of co-operating lugs or spigots 31 (shown here for clarity) and recessed tracks 43 as before described but utilising the form of core seal 12 shown in Figure 4. The operation of the closure mechanism would be by rotation as before described except that as the cap 10 is rotated anticlockwise to disengage it from the container neck 13, the lugs or spigots 31 would pass the lower face of the outer skirt 15 of the core seal 12 at the 'over-centre position' 64 causing said core seal 12 to exert a downward axial force upon the cap 10 and associated lugs or spigots 31, thus holding the cap 10 in place upon the container neck 13 with said lugs or spigots 31 at the lowest portion of the recessed tracks 43. Further anticlockwise rotation will again cause the core seal 12 to pass its position of maximum tension or 'over-centre position' 64 as before described at which point it will exert an upward axial force thus aiding removal of the cap 10 from the container neck 13. It will be seen that on reconnection there is provided an intermediate closed position at the lowest point in the recessed tracks 43 prior to the secure or locked position at the leftward end of the said recessed tracks 43. The clicking of the core seal 12 as it flexes downward and upward combined with a detent section 44 as before described could provide additional security and child resistance.

Figure 21 shows how the form of core seal 12 from Figure 4 could be utilised without conventional means of fastening between the cap 10 and the container neck 13 in the form of a universal closure for containers of a given standard

neck size. The container neck 13 shown represents a standard 38mm. nominal bore helical screw closure and upon the left hand side the cap 10 and core seal 12 are shown in the open position while on the right hand side said cap 10 and core seal 12 are shown in the closed position having been subjected to downward axial force. A central connection as before described is here shown in the form of a pin 24 projecting downwards from the cap 10 and a cylinder provided by the central shaft 23 of the core seal 12 interconnected by means of annular rings 25 and 26. Provided that the internal diameter of the skirt of the cap 10 is greater than the outside diameter of the helical scrolls upon the standard container a secure closure will be effected, and a circumferentially raised profile 65 or other means of improving manual grip may be provided upon the external circumference of the cap 10 to facilitate opening of the closure.

Figure 22 shows a section through the cap 10 revealing the mechanism illustrated in Figure 21 provided with a rotary means of attachment to facilitate its operation independent of any means formed upon the container neck, which is not shown here. A plurality of lugs or spigots 31 project inwards from the skirt of the cap 10 to bear upon a corresponding number of guides or ramps 66 formed circumferentially upon the lower face of the face ring 14, which is extended circumferentially outwards to accommodate such guides or ramps 66 at a greater internal diameter than the outer diameter of the container neck 13. Each guide or ramp 66 is provided with a relatively lower portion to provide an end stop 67 and is optionally formed with relatively raised sections or cutaways 68 at such point where the lugs or spigots 31 are detained by the end stop 67. Optional cutaways 68 provided in the central section of the guides or ramps 66 will permit the assembly to remain secured to the container neck in an intermediate position if a spout or nozzle is provided upon the cap as later described. An extension 69 to the guides or ramps 66 may be provided to assist in removing the cap 10.

The core seal 12 illustrated is in the form shown in figure 4 although the form of core seal from Figure 1 will perform equally well, while an external annular ring 70 is shown formed upon the outer circumference of the face ring 14 which in co-operation with an internal annular ring 71 upon the skirt of the cap 10 will limit the axial travel of the mechanism. In practice such limitation will generally be provided by the core seal 12 in any of the embodiments featuring a central connection between the cap 10 and the core seal 12.

Figure 23 also shows the core seal 12 as in Figure 4 but provided with a hollow central shaft 23 which in co-operation with a central hole in the cap will form an outlet or nozzle 73 to the cap 10. A valve is here provided by means of a valve plate 74 having holes, slots or cut-outs 75 peripherally around a solid central area shown here with an upward conical projection which forms a seal 76 against the hollow central shaft 23 in its lower or closed position. The valve plate 74 may be located within the neck in a variety of ways herein described but is shown here with an integral skirt 77 with walls of thin section capable of conforming to the outer skirt 15 of the core seal 12 in such a way as to provide a tight seal within the container neck 13. As has been described previously, axial force exerted downwards upon the cap 10 by any means will cause the core seal 12 to flex forcibly downwards against the seal 76 upon the valve plate 74. No additional means of attachment is shown although conventional means or novel means herein described will be required for specific applications.

Figure 24 shows a variation upon the previous figure wherein the hollow central shaft 23 of the core seal 12 is extended through the central hole 78 provided in the cap 10 to form an outlet 72 having for example a flexible spout or tube 79 attached thereto. The central shaft 23 is provided with a lower external cylindrical section forming a shoulder 80 of larger diameter than the central

hole 78 provided in the cap 10 in order to limit the upward axial movem nt of the core seal 12 which as shown here has no outer skirt 15 as before described in Figure 23 but relies for its location upon an internal annular ring or rings 81 upon the inner face of the cylindrical skirt 77 integral with the valve plate 74. Such cylindrical skirt 77 is here furnished with a circumferential face ring 14 upon its upper edge. Optionally said core seal 12 may be furnished with face ring 14 and outer skirt 15 while the valve plate 74 may be located within the container neck 13 by means of an internal annular ring. Operation of the mechanism is by means of upward manual force upon the outlet 72 of the central shaft 23 or any optional extension such as the flexible spout 79. The cap 10 and the container neck 13 may be of conventional scroll threaded design so that the assembly is capable of attachment to existing containers such as gearbox lubricant packs, or else by means of co-operating annular rings as before described or by novel means herein described. Since there is no provision for return air to the container, the configurations shown in Figure 23 and Figure 24 are most suitable for use with flexible containers.

Figure 25 shows a further variation of the arrangement shown in Figure 23 in order to accomodate the intake of air and provide an eccentric spout 82 suitable for pouring, in which operation of the closure is achieved either by rotary or axial force by means as before described. The cap 10 is shown in the closed position attached centrally to the core seal 12 which is held within the valve plate 74 and its associated cylindrical skirt 77. Said skirt 77 is here provided with a face seal 14 bearing upon the upper annular surface of the container neck 13 although optional arrangements as before described may be utilised. The lower skirt 22 of the core seal 12 is additionally provided with holes or slots 84 arranged peripherally around the central shaft 23 to allow outflow of material and inflow of air. An airtight seal is provided by the pressure of the core seal 12 upon the valve plate 74. The central shaft 23 may

be extended vertically downwards below the lower skirt 22 to which it is attached having a bevelled shoulder 83 as shown to fit within a concentric hole or aperture 85 in the valve plate 74 h re shown with a co-operating bevelled shoulder 86. A circumferential arrangement of holes or slots 75 in the valve plate 74 may be additionally provided with or without said central hole or aperture 85 and extension the central shaft 23 as described above. In this case it will be desirable to provide a concentric flap or ring 87 upon the lower face of the core seal 12 to seal within a concentric groove or recess 88 fashioned upon the upper surface of the valve plate 74 at a radius between the radius of the holes or slots 75 in the valve plate 74 and the radius of the holes or slots 84 in the core seal 12. The said valve plate 74 in this case requires to be formed with its base angled down towards its centre in order to mate with the whole face of the lower skirt 22 of the core seal 12 in the closed position.

Upon raising of the cap 10 an upward axial force will be exerted on the central shaft 23 by said lower skirt 22 of the core seal 12 thus raising the cap 10 to its upper or open position at which point material will be able to flow from below the valve plate 74 either by way of the holes or slots 75 or by way of the central hole 85 provided therein and through the holes or slots 84 in the core seal 12 to the eccentric spout 82. Air shafts 89 may be provided as shown in the cap 10 on the circumference of its skirt or on its upper surface on the side diametrically opposite the said eccentric spout 82. In the lower position such air shafts 89 would be sealed by the face ring 14 while in the upper position they would be open to the internal cavity formed by the cap 10 and the core seal 12. The central shaft 23 is here shown in its alternative form as a cylinder attached by means of interconnecting annular rings 25 and 26 to a projecting pin 24 on the cap 10. Such cap 10 may be attached to the container neck in any way hereinbefore described, and an eccentric spout 82 is provided

to facilitate pouring. A central spout or nozzle may optionally be provided which would connect with the internal cavity between the cap 10 and the core seal 12 by means of forming holes or slots in the cylindrical portion of the central shaft 23.

CLAIMS

1. A closure device comprising lid, top or cap attached to or detaining a compressible core seal applied to the fastening of such lid, top or cap to a bottle, tube, tin, jar or other container such that once in place within the neck or outlet of the container the core seal will expand circumferentially outwards under downward axial pressure upon its central section creating a tight seal within the core or bore of said neck or outlet while the same compression of the core seal will act axially between the lid, top or cap and bottle, tube, tin, jar or other container tending to urge them apart.

2. A closure device as claimed in Claim 1 such that the same compression of the core seal will at a certain point act axially between the two other members tending to hold them together.

3. A closure device as claimed in Claim 1 and Claim 2 applied to an assembly which is then attached to a bottle, tube, tin, jar or other container in order to provide a closure thereon.

4. A closure device as claimed in Claim 3 applied to an assembly which features an airlock in order to prevent refilling of the bottle, tube, tin, jar or other container.

5. A closure device as claimed in any preceding Claim featuring internal or external buttresses upon its central section to vary the performance of the compressible core seal.

6. A closure device as claimed in any preceding Claim which relies upon means other than a face sealing ring for its vertical location.

7. A closure device as claimed in any preceding Claim featuring inner and outer lids, tops or caps in order to provide a child resistant feature.

8. A closure device as claimed in Claims 1 to 6 featuring a means of attachment as described with reference to Figure 9 and Figure 10.

9. A closure device as claimed in Claims 1 to 6 featuring a means of attachment as described with reference to Figure 11 and Figure 12.

10. A closure device as claimed in Claims 1 to 6 featuring a means of attachment as described with reference to Figure 13 and Figure 14.

11. A closure device as claimed in Claims 1 to 6 featuring a means of attachment as described with reference to Figure 16.

12. A closure device as claimed in Claims 1 to 6 which features a means of attachment as described with reference to Figure 20.

13. A closure device as claimed in any preceding Claim featuring a means of attachment utilising irregularly spaced lugs or spigots and correspondingly spaced guides or tracks.

14. A closure device as claimed in Claims 8 to 12 where an annular extension to the guide tracks is provided towards the top of the container neck in order to secure the cap upon the container in the open position e.g. in connection with a spout thereon or slot upon the circumference thereof.

15. A closure device as claimed in Claims 8 to 12 where such novel means of attachment does not require specific use of the compressible core seal.

16. A closure device as claimed in Claims 1 to 6 where the compressible core seal is attached centrally by means of a projection from one member connecting by means of annular rings or chamfered shoulders with a cylindrical section or segments thereof upon the other member.

17. A closure device as claimed in Claims 1 to 6 where the compressible core seal is attached to the cap circumferentially by means of an annular projection or segments thereof in co-operation with an annular ring or chamfered shoulder or parts thereof upon the inner circumference of the cap.

18. A closure device as claimed in Claims 1 to 6 where the compressible core seal features a hollow central section and central hole at its apex.

19. A closure device as claimed in Claim 2 which will attach to a container neck of given size without ancillary means of attachment.

20. A closure device as claimed in Claim 1 and Claim 19 which features rotary means of attachment integral with the compressible core seal and cap.

21. A closure device as claimed in Claim 20 which features an end stop and detent cutaways and rotary means of detachment or a combination thereof.

22. A closure device as claimed in Claim 19 and Claim 20 wherein an outlet is provided in the centre of the cap in conjunction with a valve plate as herein described.

23. A closure device as claimed in Claim 19 and Claim 20 wherein an outlet is provided eccentrically in the cap in conjunction with a valve plate as described with reference to Figure 25.

24. A closure device as claimed in Claim 4 where an airlock is featured but where conventional means of attachment of the cap are utilised.

25. A closure device as claimed in any preceding Claim which features a tamper evident strip which will become wholly or partly detached when downward axial force is applied to the lid, top or cap.

26. A closure device as claimed in any preceding Claim which features a tamper evident strip as described with reference to Figure 19.

27. A closure device substantially as herein described with reference to Figures 1 to 25 of the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) -32-	Application number GB 9316299.8
Relevant Technical Fields (i) UK Cl (Ed.M) B8T (TCM, TCP, TPM, TPA, TWH) (ii) Int Cl (Ed.5) B65D 39/12, 39/16, 41/28, 45/02	Search Examiner M J RICHARDSON Date of completion of Search 26 JANUARY 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-27

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2155985 A	(VICTORY) - see page 1 lines 79-83	13
X,Y	GB 723545	(DRUG HOUSES) - see entire document	X: 1,3,7,19, 20,25 at least Y: 13
X	US 4397397	(KERR) - see Figure 2 and column 4 line 65 - column 5 line 7	1,3,6,19 at least

Databases:The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).